Remarks

I. Status of claims

Claims 47, 48, 50-55, and 57-66 are pending.

The Examiner has indicated that claims 62 and 64-66 would be allowable if rewritten in independent form.

II. Claim rejections under 35 U.S.C. § 102

The Examiner has rejected claims 50, 55, 57, 61, and 63 under 35 U.S.C. § 102(b) over Choquette (U.S. 5,493,577).

A. Claims 50, 57, 61, and 63

Independent claims 50 and 57 recite that the reliability-enhancing layer is configured to at least in part "balance" strain created by the defect source.

In the Response to Arguments section of the Office action dated March 16, 2006, the Examiner has stated that:

> ... The examiner agreed with the applicant with regards to claims 51-53 and 58-60, in as much as the strain from the defect source may not necessarily be compensated by tensile strain by the sub-layers, but the sub-layers may be simply providing additional spacing from the defect source to the active region (Remarks, pg. 9, para. 1). Once again, the examiner agrees that the sub-layers may in fact be simply providing the increased spacing as suggested by the applicant, but that in doing so they are acting in part to balance the strain by the defect source as outlined via the claim limitation. ...

In a telephone conference on May 30, 2006, the Examiner and Mr. Garcia discussed the meaning of the term "balance" recited in claims 50 and 57. During this discussion, the Examiner and Mr. Garcia agreed that in the context of claims 50 and 57 the ordinary and accustomed meaning of the term "balance" is to counterbalance or offset (see, e.g., Merriam-Webster's Collegiate Dictionary, 10th Ed.). The Examiner and Mr. Garcia also agreed that reducing strain effects in the active region 18 simply by increasing the distance between the

oxidized control layer 20 and the active region 18 does not at least in part "balance" the strain created by the oxidized control layer 20 in accordance with the ordinary and accustomed meaning of the term.

Since the sub-layers of the control layer 20 do not produce any appreciable strain and only reduce strain effects in the active region 18 by increasing the distance between the oxidized control layer 20 and the active region 18, these sub-layers cannot reasonably be considered to be configured to at least in part "balance" strain created by the oxidized control layer 20.

For at least these reasons, the Examiner's rejection of independent claims 50 and 57 under 35 U.S.C. § 102(b) over Choquette should be withdrawn.

Claim 61 incorporates the features of independent claim 50 and therefore is patentable over Choquette for at least the same reasons explained above.

Claim 63 incorporates the features of independent claim 57 and therefore is patentable over Choquette for at least the same reasons explained above.

B. Claim 55

Claim 55 has been amended and now recites that the first and second reliability-enhancing layers produce localized strain fields.

In the Response to Arguments section of the Office action dated March 16, 2006, the Examiner has indicated his agreement with Applicants' explanation that the sub-layers of the control layer 20 do not produce any appreciable strain that reduces defect-induced degradation of the active region by the defect source (see § II.B.1 of Amendment filed January 6, 2006).

For at least this reason, the Examiner's rejection of claim 55 under 35 U.S.C. § 102(b) over Choquette now should be withdrawn.

III. Claim rejections under 35 U.S.C. § 103

A. Claims 47 and 54

Each of claims 47 and 54 recites in pertinent part that:

⇒ the first mirror stack, the cavity region, and the second mirror stack are arranged along a vertical direction, and

⇒ reliability-enhancing layer is positioned within the defect source and produces a localized strain field within the defect source to reduce migration of defects in the vertical direction from the defect source to the active region.

The Examiner has rejected claims 47 and 54 under 35 U.S.C. § 103(a) over Ramdani (U.S. 5,835,521) in view of Shieh (U.S. 5,838,705).

In this rejection, the Examiner has relied on the alternative embodiment of Ramdani's VCSEL that includes a proton implantation region. In this embodiment, the first DBR mirror structure 10 and the active VCSEL device structure 20 are wafer fused together (see col. 5, lines 33-44) and then, instead of etching the contact layer 28, the current spreading layer 31, the cladding region 30, and the active region 34 as shown in FIG. 3, proton implantation is "utilized for current isolation" (see col. 5, lines 50-52). The Examiner has indicated that the proton-implanted region corresponds to the defect source recited in claims 47 and 54 and that the current spreading layer 31 corresponds to the reliability-enhancing layer recited in claims 47 and 54.

In a telephone conference on May 31, 2006, the Examiner and Mr. Garcia agreed that the most reasonable interpretation of Ramdani's disclosure of the alternative embodiment in col. 5, lines 50-52, would result in a structure in which annular regions of one or more of the contact layer 28, the current spreading layer 31, and the layers of the cladding region 30 and the active region 34 have been subjected to proton implantation in order to create a current isolating implant region surrounding a current aperture. This interpretation is bolstered by the fact that the second distributed Bragg reflector 42 is not deposited onto the contact layer 28 until after the proton-implanted region has been formed (see col. 6, lines 4-12).

In the agreed upon structure of Ramdani's alternative embodiment, the proton-implanted region is not on top of the contact layer 28. Instead, the proton-implanted region is an annular region that surrounds a current aperture through one or more of the contact layer 28, the current spreading layer 31, and the layers of the cladding region 30 and the active region 34. Therefore, although a portion of the contact layer 28 conceivably may be located in the annular proton-implanted region, it does not produce a localized strain field within the defect source that reduces migration of defects in the vertical direction from the defect source to the active region, as recited in claims 47 and 54.

Since Shieh does not provide any suggestion or motivation that would have led one skilled in the art to change the arrangement of Ramdani's contact layer 28 in relation to the proton-implanted region, the Examiner's rejection of claims 47 and 54 under 35 U.S.C. § 103(a) over Ramdani in view of Shieh should be withdrawn for at least this reason.

The Examiner's rejection of claims 47 and 54 under 35 U.S.C. § 103(a) over Ramdani in view of Shieh also should be withdrawn for the following additional reasons.

First, there is no basis for the Examiner's implication that one skilled in the art would recognize Ramdani's contact layer 28 as corresponding to a reliability-enhancing layer. As a result, one skilled in the art at the time the invention was made would not have been motivated to incorporate Shieh's defect inhibition layer into Ramdani's contact layer 28.

Second, each of claims 47 and 54 recites that the reliability enhancing layer produces a localized strain field within the defect source. The Examiner has acknowledged that "Ramdani does not teach the reliability enhancing layer to produce a strain field" (page 6 of the Office action dated March 16, 2006). To make-up for this lack of disclosure, the Examiner has stated that:

> Shieh teaches a VCSEL with a reliability enhancing layer that produces strain (col. 3, lines 7-10). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the VCSEL of Ramdani with the strain producing reliability enhancing layer of Shieh in order to prohibit movement of defects to the active region.

Shieh's disclosure, however, would not have led one skilled in the art at the time the invention was made to form within a defect source a defect inhibition layer that produces a localized strain field within the defect source, as recited in claims 47 and 54. The only guidance provided by Shie regarding the specific locations where the defect inhibition layers are contained is in the cladding regions. For example, in the ridge VCSEL 101 and the planar VCSEL 201, Shieh teaches that the defect inhibition layers 117, 136 and 217, 236 are formed in the cladding regions 114, 132 and 214, 232. Shieh does not expressly teach that the defect inhibition layers could be formed within the DBRs, much less within a defect source, such as the damaged region 206, that is formed in one of the DBRs. Although Shieh states that "a defect inhibition layer, or layers, illustrated by defect inhibition layers 117 and 136, are formed anywhere outside active area 122" (col. 2, lines 50-52), reliance on such disclosure for a suggestion to form Shieh's defect inhibition layer within the proton-implanted region of Ramdani's alternative embodiment amounts to no more than the impermissible "obvious to

try" rationale, which is not the proper standard under 35 U.S.C. § 103 (see MPEP § 2145.X.B).

Third, Shieh teaches that the defect inhibition layers are made of any suitable indium containing material, such as indium gallium arsenide (InGaAs), indium gallium arsenide phosphide (InGaAsP), indium gallium phosphide (InGaP), or the like (see, e.g., col. 3, lines 7-10). Since the active structure 20 (see, e.g., FIG. 2) of Ramdani's VCSEL is formed from the same material family (see col. 4, line 38 - col. 5, line 23), the defect inhibition layers disclosed in Shieh reasonably can be expected to be substantially lattice-matched to the layers in the active structure 20 of Ramdani's VCSEL. Consequently, Shieh's defect inhibition layers cannot reasonably be expected to produce any appreciable strain that reduces migration of defects in the vertical direction from the defect source to the active region.

For at least these reasons, the Examiner's rejection of claims 47 and 54 under 35 U.S.C. § 102(b) over Ramdani in view of Shieh should be withdrawn.

B. Claims 48, 52, 53, 59, and 60

The Examiner has rejected claims 48, 52, 53, 59, and 60 under 35 U.S.C. § 103(a) over Choquette in view of Shieh.

1. Claim 48

Claim 48 recites that the first and second reliability-enhancing layers produce localized strain fields and are located on opposite sides of the defect source.

In his rejection of claim 48, the Examiner has indicated that the oxidized portion of the aluminum-containing control layer 20 constitutes a defect source and the one or more sub-layers of the control layer 20 that are described in col. 12, line 66 – col. 13, line 19 constitute first and second reliability enhancing layers located on opposite sides of the defect source. The Examiner has acknowledged that "Choquette does not disclose the reliability-enhancing layers to produce a strain field." To make-up for this lack of disclosure, the Examiner has stated that:

> Shieh teaches a VCSEL with a reliability enhancing layer that produces strain (col. 3, lines 7-10). It would have been obvious to one of ordinary skill in the art at the time of the invention to

combine the VCSEL of Ramdani with the strain producing reliability enhancing layer of Shieh in order to prohibit movement of defects to the active region.

Shieh's disclosure, however, would not have led one skilled in the art at the time the invention was made to form defect inhibition layers on opposite sides of the oxidized portion of the aluminum-containing control layer 20 disclosed in Choquette, as proposed by the Examiner.

First, the top sub-layers of the control layer 20 do not increase the distance between the oxidized control layer 20 and the active region 18 and therefore, have no readily apparent effect on reducing strain effects in the active region 18. Consequently, there is no basis for the Examiner's implication that one skilled in the art would recognize the top sub-layers of the control layer 20 as corresponding to reliability-enhancing layers. As a result, one skilled in the art at the time the invention was made would not have been motivated to incorporate Shieh's defect inhibition layer into the top sub-layers of Choquette's control layer 20.

Second, Shieh does not teach or suggest anything that would have led one skilled in the art to provide his defect inhibition layers on opposite sides of a *defect source* located in a DBR as disclosed in Choquette. Indeed, the only guidance provided by Shie regarding the specific locations where the defect inhibition layers are contained is in the cladding regions, which are located on opposite sides of the *active region*.

For at least these reasons, the Examiner's rejection of claim 48 under 35 U.S.C. § 103(a) over Choquette in view of Shieh should be withdrawn.

2. Claims 52 and 59

Claim 52 incorporates the features of independent claim 50 and claim 59 incorporates the features of independent claim 57. Shieh does not make-up for the failure of Choquette to teach or suggest anything about a reliability-enhancing layer that is configured to at least in part "balance" strain created by the defect source.

For at least this reason, the Examiner's rejection of claims 52 and 59 under 35 U.S.C. § 103(a) over Choquette in view of Shieh should be withdrawn. This rejection also should be withdrawn for the following additional reasons.

Each of claims 52 and 59 recites that at least one of the first and second mirror stacks comprises oxidized AlGaAs layers, the defect source corresponds to at least one of the

oxidized AlGaAs layers, and the reliability-enhancing layer is formed from $In_xGa_{1-x}P$, wherein $x < 0.5$ tensile.

In his rejection of claims 52 and 59, the Examiner has stated that:

> With respect to claims 52 and 59, Choquette teaches the VCSEL outlined in rejection of claim 50 above, comprising a first mirror stack comprising layers of oxidized AlGaAs (col. 9 lines 11-12), and a reliability enhancing layer which reduces strain and degradation effects in the active region (col. 13 lines 8-11). Choquette does not teach the layer to be made of InxGa1-xP. Shieh teaches a reliability enhancing layer made of lnGaP that reduces strain and degradation effects in the active region (col.3 lines 10-15). Neither source teaches that x should be less than .5 tensile. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the reliability enhancing layer of Choquette with the reliability enhancing layer material type of Shieh as an obvious design choice to fit the material system which is being worked with; in addition it would have been obvious to use x less than .5 tensile as it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 227 F.2d 197, 125 USPQ416 (CCPA 1960).

With this rejection, the Examiner has not established a *prima facie* case of obviousness under 35 U.S.C. § 103(a). In particular, the Examiner has not provided the requisite factual basis and failed to establish the requisite motivation to support his deemed conclusion that the features recited in claims 52 and 59 would have been obvious to one of ordinary skill in the art at the time of the invention. The Examiner's conclusory assertion that the claimed features of claims 52 and 59 are "an obvious design choice" does not meet the Examiner's obligation to point to some teaching or suggestion in Choquette or Shieh that would have led one of ordinary skill in the art to the invention recited in claims 52 and 59. In this regard, the Examiner is obligated to explain why one skilled in the art would have been motivated to balance the strain created by an oxidized AlGaAs layer in a DBR with a reliability-enhancing layer that is formed from $In_xGa_{1-x}P$, wherein $x < 0.5$ tensile, when neither Choquette nor Shieh teaches or suggests anything about balancing the strain created by an oxidized AlGaAs layer.

If the Examiner persists with these rejections, he is requested to cite other art in support of his assertions. Alternatively, if the Examiner is aware of facts within his personal knowledge that provide the requisite factual basis and establishes the requisite motivation to

support his deemed conclusion that the features recited in claims 52 and 59 would have been obvious, the Examiner is requested to provide an affidavit in accordance with 37 CFR § 1.104(d)(2). Otherwise, the Examiner's rejection of claims 52 and 59 should be withdrawn for at least this reason.

Finally, MPEP § 2144.03B explains the obligations of the Examiner when taking official notice of a fact that is asserted to be common knowledge without specific reliance on documentary evidence (citations omitted):

> If such notice is taken, the basis for such reasoning must be set forth explicitly. The examiner must provide specific factual findings predicated on sound technical and scientific reasoning to support his or her conclusion of common knowledge. .... The applicant should be presented with the explicit basis on which the examiner regards the matter as subject to official notice and be allowed to challenge the assertion in the next reply after the Office action in which the common knowledge statement was made.

In his rejection of claims 52 and 59, the Examiner did not provide any basis or factual findings that support his assertion that the use of $In_xGa_{1-x}P$, wherein $x < 0.5$ tensile, was a material that was known to be suitable for balancing the strain of oxidized AlGaAs layers in a mirror stack for the intended purpose of reducing defect-induced degradation of one or more VCSEL regions. Instead, the Examiner merely has assumed that the facts relied upon were generally known at the time the invention was made. If the Examiner persists with these rejections, he is required under MPEP § 2133.03B to provide specific factual findings that show that the use of $In_xGa_{1-x}P$, wherein $x < 0.5$ tensile, was a material that was known to be suitable for balancing the strain of oxidized AlGaAs layers in a mirror stack for the intended purpose of reducing defect-induced degradation of one or more VCSEL regions was indeed well known in the art. If the Examiner cannot comply with the requirements of MPEP § 2133.03B, the Examiner's rejection of claims 52 and 59 under 35 U.S.C. § 103(a) over Choquette, Shieh, and the unsubstantiated prior art should be withdrawn for this additional reason.

3. Claims 53 and 60

Each of independent claims 53 and 60 recites that the reliability-enhancing layer introduces strain that reduces the defect migration introduced by the concentration gradient created by the defect source.

The Examiner's rejection of claims 53 and 60 over Choquette and Shieh is premised on the Examiner's unsubstantiated assumption that the oxidized control layer 20 disclosed in Choquette "creates a concentration gradient inducing defect migration." However, there is no reasonable basis for believing that the oxidized portion of the aluminum-containing control layer 20 "creates a concentration gradient inducing defect migration." Indeed, one skilled in the art at the time the invention was made reasonably would have understood that any defects in the crystal structure that were created by the oxidation of the aluminum-containing control layer 20 would be localized at the interface between the aluminum oxide and the adjacent unoxidized semiconductor crystal. Consequently, the oxidized portion of the aluminum-containing control layer 20 would not create a "concentration gradient".

For at least this reason, the Examiner's rejection of claims 53 and 60 under 35 U.S.C. § 103(a) over Choquette in view of Shieh should be withdrawn.

If the Examiner persists with these rejections, he is requested to cite other art in support of his assertion the oxidized control layer 20 disclosed in Choquette "creates a concentration gradient inducing defect migration." Alternatively, if the Examiner is aware of facts within his personal knowledge that provide the requisite factual basis for this assertion and establishes the requisite motivation to support his conclusion that the features recited in claims 52 and 59 would have been obvious, the Examiner is requested to provide an affidavit in accordance with 37 CFR § 1.104(d)(2). Otherwise, the Examiner's rejection of claims 52 and 59 should be withdrawn for at least this reason.

C. Claims 51 and 58

The Examiner has rejected claims 51 and 58 under 35 U.S.C. § 103(a) over Choquette in view of Jewell (U.S. 6,269,109).

Claim 51 incorporates the features of independent claim 50 and claim 58 incorporates the features of independent claim 57. Jewell does not make-up for the failure of Choquette to

teach or suggest anything about a reliability-enhancing layer that is configured to at least in part "balance" strain created by the defect source. Indeed, Jewell does not teach or suggest anything about balancing strain created by a defect source. The section of Jewel cited by the Examiner merely teaches that the use of compressive strain in a non-oxidizing layer and/or the use of tensile strain in an oxidizing layer will promote the transfer of non-Al materials from the non-oxidizing layer to the oxidizing layer and, thereby, minimize the dosage of implantation required to produce sufficient interdiffusion to form an oxidation barrier.

For at least this reason, the Examiner's rejection of claims 51 and 58 under 35 U.S.C. § 103(a) over Choquette in view of Jewell should be withdrawn.

IV. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 50-1078.

Respectfully submitted,

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